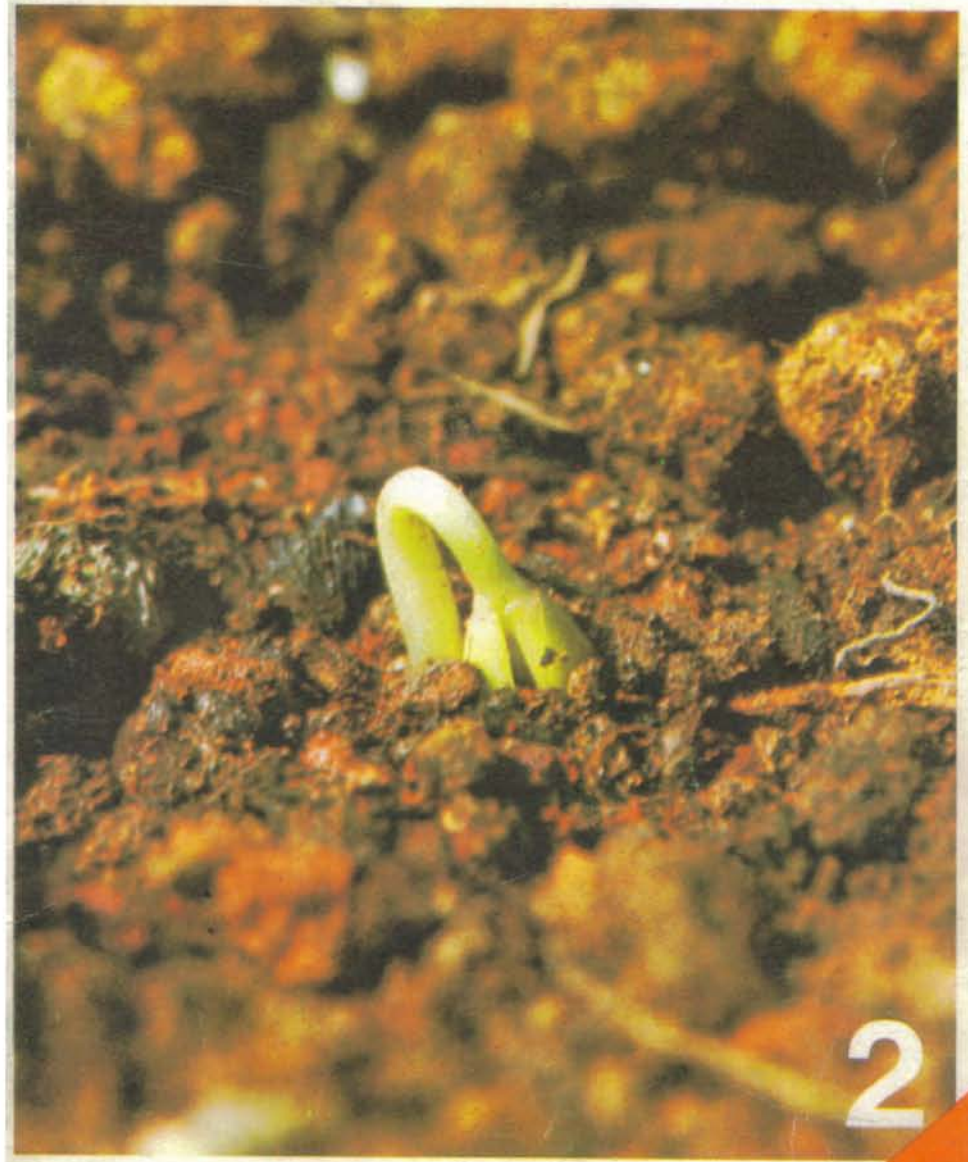
BASIC SCIENCE SERIES



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EARTH

REVISED EDITION

BASIC SCIENCE SERIES — BOOK 2

REVISED EDITION

EARTH

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PREFACE

In the present technological era it is important that all children should be given a basic training in scientific knowledge. The Basic Science Series is written with this aim in mind.

The series includes 16 scientific topics each of which is a complete information book. In its entirety the scheme covers the syllabus generally adopted by upper primary classes and lower secondary forms.

The text is supported by attractive illustrations and is written in a style acceptable to a wide range of pupils.

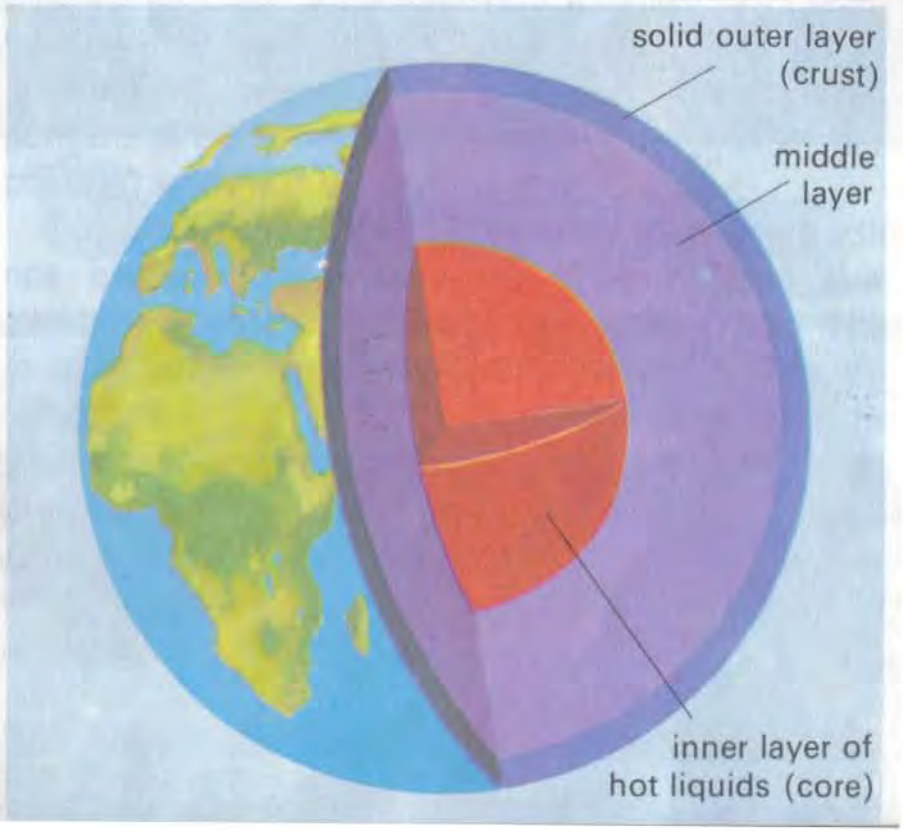
A strong feature of each of the books is the inclusion of many simple experiments under the section "Things to Do". This encourages the pupil to keep his own project book and ultimately assists his understanding of Science.

CONTENTS

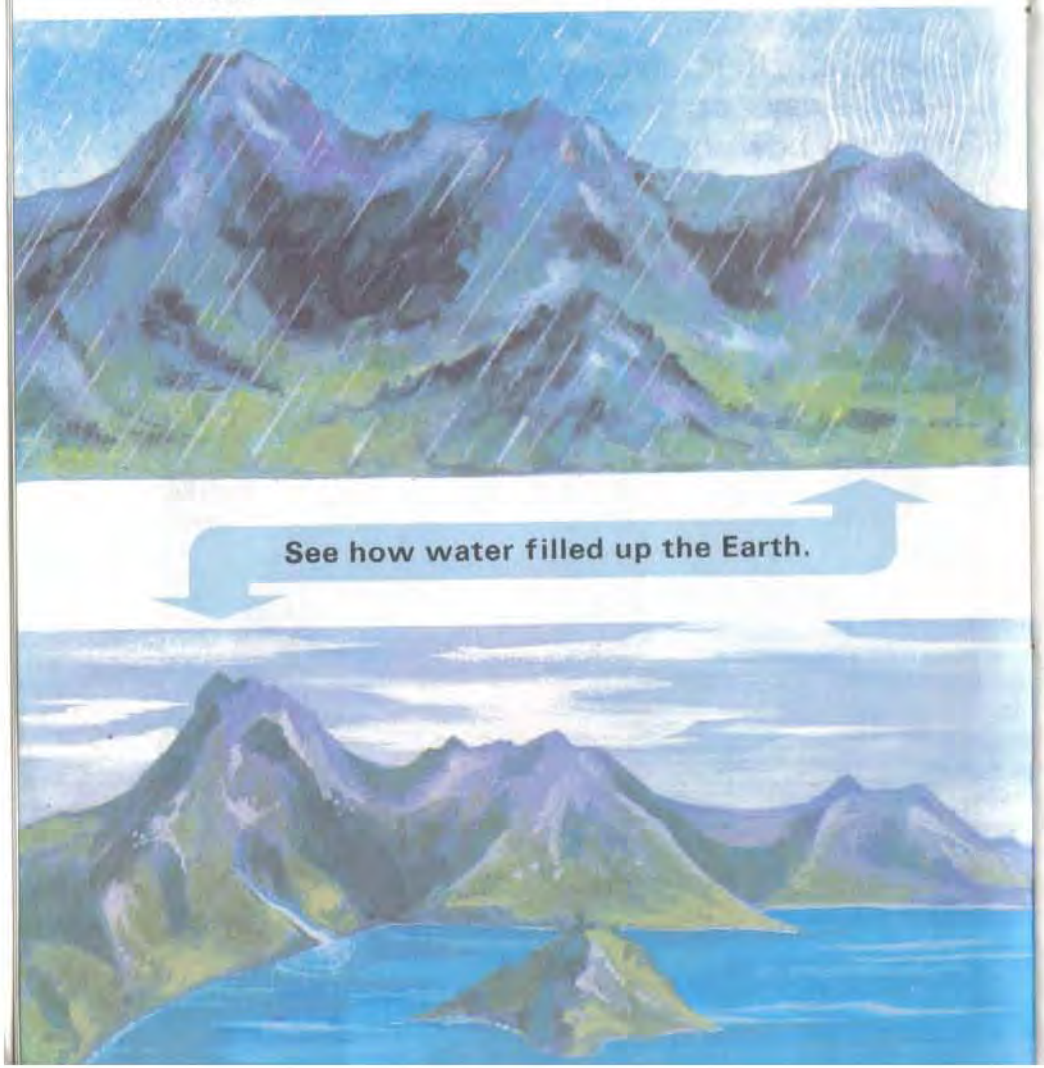
OUR PLANET EARTH

The Earth which we live on is a beautiful planet. It is made up of land and oceans, mountains and rivers, plants, animals and people. It is actually very, very old and was not always as beautiful as it is now. It is not certain how the Earth began. Probably it began as a huge globe of gas and dust. The globe became smaller and denser, and most of the gas drifted away leaving behind bodies of solid

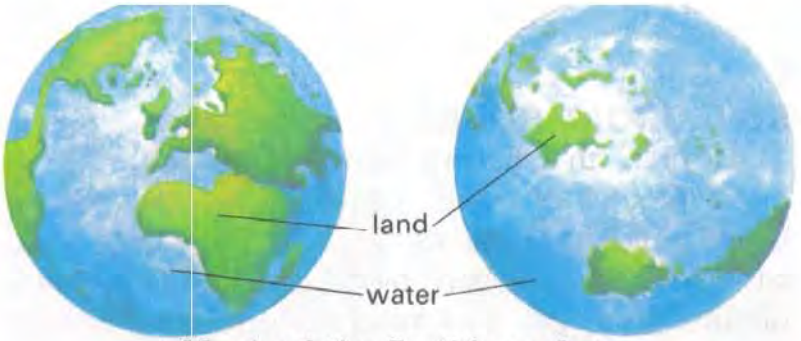
What our planet Earth is made up of.



matter. These bodies eventually collected together to form solid Earth. Then the inside of the solid Earth became hot and molten causing certain materials to rise to the surface. This probably resulted in the formation of the Earth's layers. To-day the outer layer or crust is cool and hard, while the core is probably hot and molten.



See how water filled up the Earth.



Much of the Earth's surface is covered with water.

Some of the materials which were pushed up to the crust from the molten core of the Earth formed water. Others formed the gases of the atmosphere. The water evaporated to form clouds. These rose into the sky to form rain. Soon rain fell down on the Earth's crust and filled all the valleys, cracks and hollows. In this way, rivers, lakes, oceans and seas were formed. Throughout the ages, Earth has received a lot of rainfall and now most of the Earth's crust is covered with water. About $\frac{7}{10}$th of the Earth's surface is covered with water while $\frac{3}{10}$th of it is covered with land.

For a long time the Earth's atmosphere did not contain much oxygen. The oxygen was combined with the other materials in rocks. This oxygen was slowly freed and escaped into the atmosphere. After a very long time, as the amount of oxygen in the atmosphere increased, the Earth became a more suitable place for plants to develop. Plants produced more oxygen which was freed into the atmosphere. Later on animals developed.

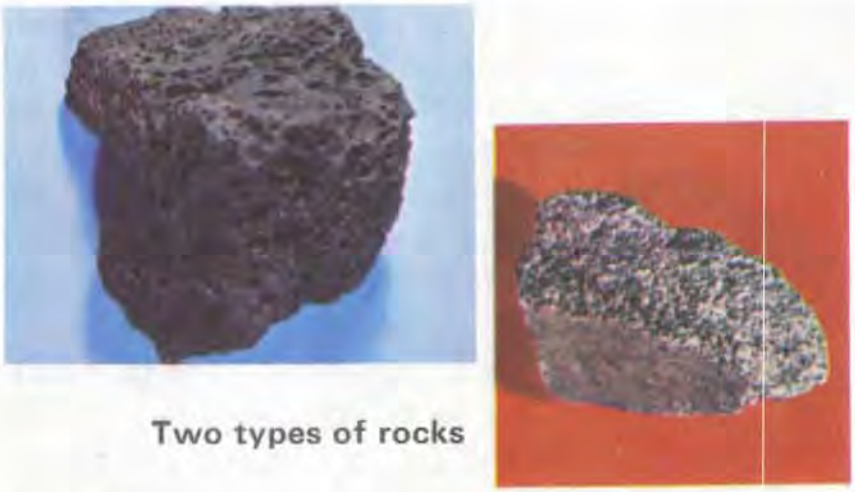
SOIL FROM ROCKS

At first, the Earth's crust was made up of huge blocks of hard, solid rocks. The outer layers of these rocks slowly broke up into smaller and smaller pieces. Finally stones, pebbles and grains of sand were formed. Many sorts of plants and animals lived and died on the surface of the Earth. Their remains mixed up with the stones, pebbles and sand of the Earth's crust to form **soil**. The outermost layer of the Earth's crust is soil.

There are many ways in which large pieces of rock break into smaller pieces. Wind, water, heat and cold help to break up rocks. When winds blow sand particles against a large rock for a long time, the softer layers of the rock are slowly worn away. These leave holes and cracks in the rock. The holes and cracks become bigger until finally the rock breaks up into smaller pieces.

The moving water of streams and rivers also helps to break large rocks into smaller pieces. As the water moves along, it carries with it small pieces of rock. These rub against the large rocks. As this happens, the larger rocks are worn down to smaller pieces. These smaller pieces are carried away and they in turn wear down other larger rocks.

The heat of the sun helps to break up rocks too. When the sun shines, the rocks become very hot. If these rocks are suddenly cooled



Two types of rocks

they may crack. Therefore, a sharp change in temperature can cause rocks to break into smaller pieces.

Ice also helps to break up rocks. When it rains, water collects in the cracks of a rock. If the weather becomes very cold, this water will turn to ice. When water becomes ice, its volume becomes bigger. Therefore, the crack becomes wider. Soon the crack becomes so wide that the rock breaks into smaller pieces.

Things to Do

(i) Let's find rocks. We can find rocks if we go into the open fields, or near the sea-shore. Collect as many rocks as you can. Take a bag or box along to put your rocks into. Write down where you found each rock and what you found near it.

(ii) Now look at your rock collection. Wash each rock with water and examine it. Is it large or small? Touch each rock to find out whether it is smooth or rough. Look at its edges. Are they rounded or jagged? Scratch each rock with a blade or pen-knife. Is it hard or soft? Describe the colour of the rock.

(iii) Let's look inside our rocks. Try to break each rock up with your hands. If the rock is too hard, use a hammer. What do you see inside the rock? Is the colour inside the rock the same as the colour outside? Do small pieces of sand fall out?

(iv) Use a hammer to pound each rock up into small pieces. Pound the pieces until they become very small. Now pour water on them and mix them with the water. Do you get sticky mud? What colour is the mud? Now you have made mud from rocks.

SOIL EROSION AND CONSERVATION

Look at the slopes of a hill on a rainy day. You will see many streams of muddy water running down the slopes. The water is muddy because it washes away soil from the hill slopes. Sometimes soil is blown away by strong winds. When the soil is carried away by water or wind we say that the land is **eroded**. This is known as **soil erosion**.

This is the result of soil erosion.

Soil erosion takes place most easily on hill slopes. Rain water runs down slopes quickly and carries plenty of soil with it. Erosion can also take place on flat, open land. Heavy rain can quickly wash away the rich top soil on flat, open land.

Plants cannot grow on eroded land. There is not enough soil on eroded land to give them the things they need. Plants need water and salts from the soil.

We must try to stop soil erosion. We can do this in a number of ways. This is known as **soil conservation**. One way of stopping soil erosion on flat, open ground is to grow small plants such as grasses. These plants are called **cover crops**. Their roots hold the soil tightly together. The rain water cannot wash

away the soil. When trees and tall bushes are planted at the edges of an open field, soil erosion by strong winds cannot take place. The trees and bushes protect the open land from the winds. They act as a very big wall.

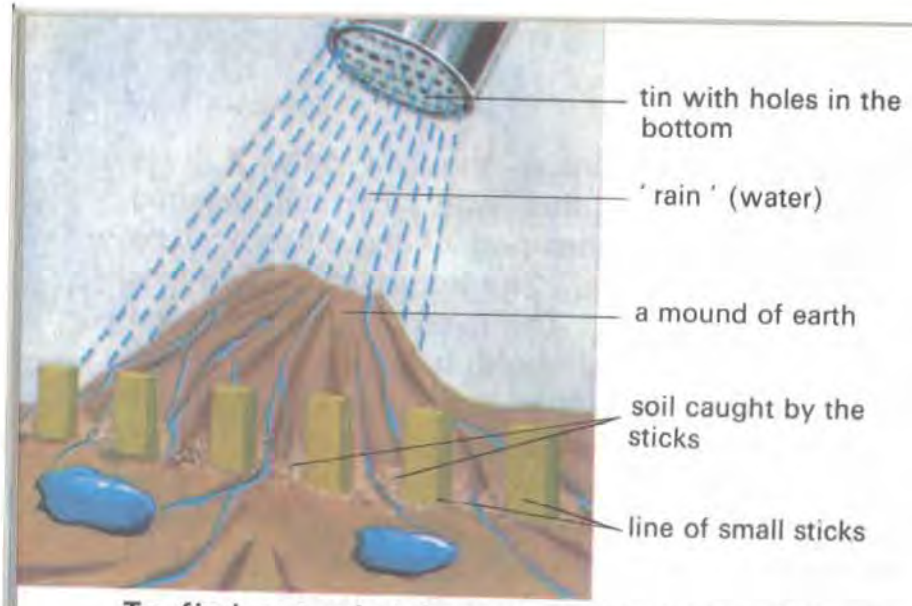
Soil erosion on slopes can be stopped in a number of ways. One way is to cut a slope into "steps" called **terraces**. Water carrying soil cannot run straight down the slope now. It has to run down the terraces. This slows down the flow of the water. Most of the soil in the water is left behind on the terraces.

Terracing stops soil erosion.

Water can carry away the soil only if it is flowing fast. In this way, the soil washed away from the upper part of the slope will be left on the terraces. The edges of the terraces can also be raised. The raised edges are called **bunds**. These will hold back the rain water and the soil it carries. Sometimes trees are planted in narrow steps cut into the hill slopes. These steps which are called **contours** slow down the flowing rain water. Cover crops growing on contours or the slopes between terraces also help to stop soil erosion.

Things to Do

(i) We can make our own rain and see what happens when it falls on different types of land. Take a big tin and make a number of holes in the bottom. Prepare a mound of loose earth. Next, find a mound of earth covered with grass or other plants. Finally find a mound of hard, dry earth. Put up a line of small sticks in the form of a fence at the bottom of each mound of earth. Now hold your tin over the mound of loose earth and with a smaller tin, pour some water into it. The water will pass through the holes at the bottom of the tin like rain. Watch it falling on the loose earth. You will see that some soil is washed away. The water flowing down the mound is not



To find out what happens when ' rain ' falls on different types of land

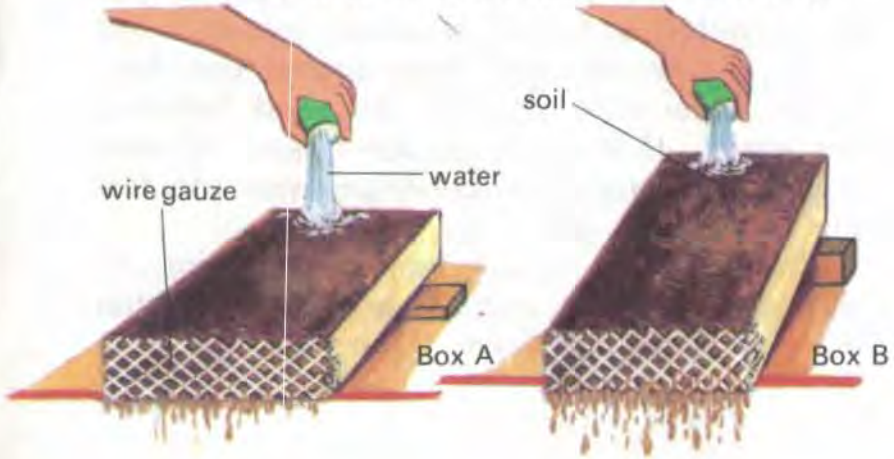
clean but brownish. This is because it is carrying away some soil. As it flows past the fence it slows down and some soil is caught by each stick. The water is eroding the mound while the fence is helping to conserve the soil. Now do the same thing with the mound covered with plants and the other made up of hard ground. See what happens and explain. Do soil erosion and soil conservation occur like before?

(ii) You can find out more about soil erosion on slopes in this way. Make two long narrow wooden boxes, both open at one end. At each open end nail a piece of wire gauze. Fill both boxes with equal amounts of the same type of soil. Tilt

both boxes, making sure that you tilt Box B much more than Box A. Now pour exactly one tin of water over the upper end of Box A and collect the muddy water from the other end. Do the same thing with Box B. Compare the amounts of soil washed away from Box A and Box B. You will find that more soil is washed away from Box B. This shows that more soil will be washed away when the slope is steeper.

This time tilt both Box A and Box B in the same way. Pour two tins of water into Box A and one tin into Box B. Collect the muddy water from both boxes, and compare the amounts of soil washed away. You will find that more soil is washed away from Box A. This shows that if there is more water, more soil will be washed away.

To find out how soil is washed away by water



Next, find a slope which is made of bare, hard soil, another of bare, loose soil and a third of soil covered with plants. Pour water on each slope and look at what happens. Is soil washed away from all the three slopes? Do the plants on the third slope help to prevent soil erosion? Now build little terraces across each slope and pour water on the slopes. Talk about what happens.

WHAT SOIL IS MADE UP OF

Soil is made up of **stones, sand, clay** and **loam**. It also contains **air** and **water**. Stones are small pieces of rock. They are larger than the other parts of soil. The stones in the soil are of all shapes and sizes.

When stones break up, they form grains of sand. The soil on the beach is mainly made up of sand. Since the grains of sand are quite big, there are many large spaces between them. Air is found in most of these spaces. Sometimes water is found in these spaces. But water can run through these spaces very fast. When water runs through, the sand becomes dry again. If you pick up some sand between your thumb and your fore-finger, you can feel the size of the grains.

Clay is made up of very small grains, or **particles**. These particles are so small that we can hardly see them. They lie very close

to each other. The spaces between them are very small. They do not contain much air. If you pick up some dry clay, it feels powdery. Wet clay is sticky and dries very slowly. This is because water does not run through it quickly. The clay holds the water back.

Loam is a mixture of clay and sand. It also has **humus**. Humus is made up of pieces of dead animals and plants. Loam is the best type of soil because it contains air, water and humus. Humus is important for plant growth. It has many types of salts. Plants use these salts for making food. Loam does not become as dry as sand or as wet as clay. The soil in most gardens is made up of loam.

Besides these things, soil also contains living things. Plants live on the surface of the soil but their roots are found in the soil. Animals live on the surface of the soil and inside it.

Things to Do

(i) Dig up some soil from the ground and place it on a piece of paper. Sort the soil out into:
   (*a*) living things,
   (*b*) things that were once alive but are now dead and
   (*c*) things that were never alive at all.
   Talk about what you have found in each group.

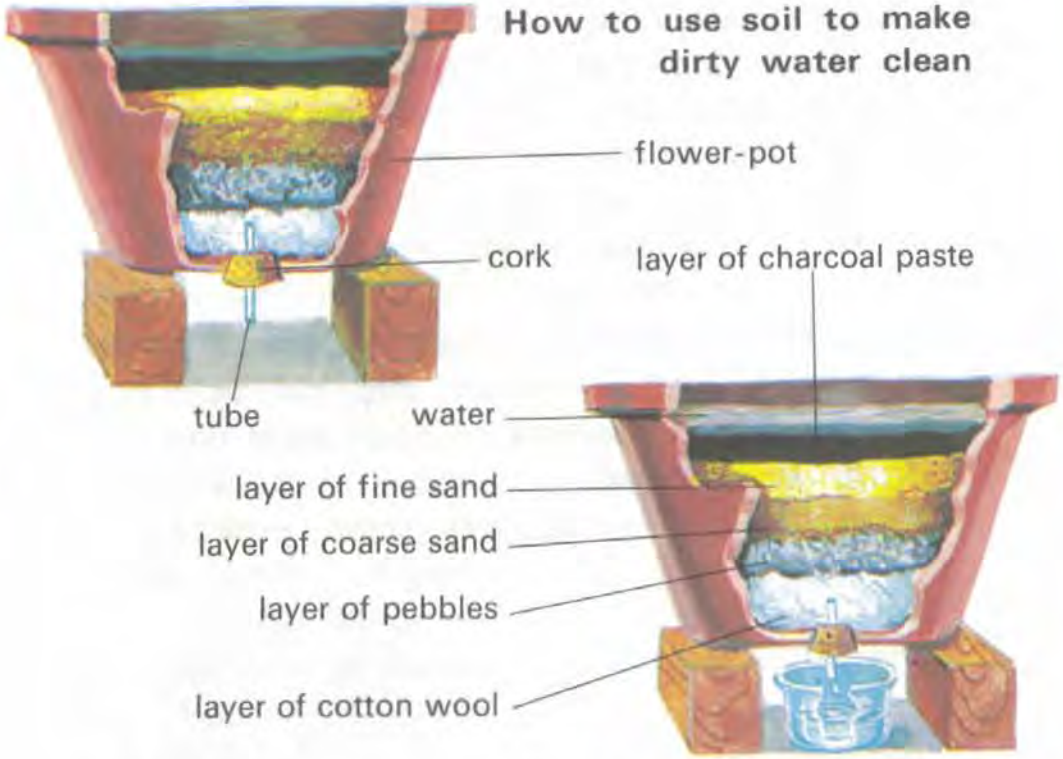
(ii) We can show what soil is made up of in this way. Take some soil from your school garden and put it into a bottle. Fill only about half the bottle with soil. Fill the bottle with water and close the mouth with a cover. Shake it and place it on the table again. You will see that the larger stones will sink to the bottom. The smaller ones will lie above these. Large grains of sand lie on the top of the stones. This will be followed by smaller grains of sand. Above these will be small fine grains of clay. The water above the clay is cloudy because there are many tiny clay particles floating in it. The things floating on the surface of the water are bits of humus. The heaviest particles sink first and the lightest particles sink last.

To find out what soil is made up of

(iii) Examine different types of soil such as sandy, garden, clayey and swampy soil. Look at the colour of each type and feel it. In this way, you can find out whether the grains are large or small, powdery or sticky, smooth or rough. How much humus can you see in each type of soil?

(iv) Collect some dry, coarse sand. Look at the grains of sand through a hand lens and describe the colours of the grains. Look for pieces of bone, shell and coral among the grains. Place the grains end to end along a ruler. How many grains fit within a length of 1 cm? Sprinkle the sand on a piece of paper. Roll a bottle over the sand and see what happens.

(v) Let's make shapes with sand and clay. Collect a few handfuls of sand and clay and place them in two separate piles. Mix each pile with some water. Now make different shapes with the wet sand and clay. Is it easier to make shapes with the wet clay or with the wet sand? Why?



How to use soil to make dirty water clean

(vi) You can use soil to make dirty water clean. Take a flower-pot which has a hole at the bottom. Fit a cork with a tube in this hole. Spread a layer of cotton wool over the bottom of the pot. Put a layer of pebbles over this. Follow with a layer of coarse sand, a layer of fine sand and last of all, a layer of charcoal paste. Now pour some muddy water into the flower pot. Collect the water that comes out of the tube at the bottom. Is the water you have collected clean or muddy? Can you explain how this happened?

SOIL CONTAINS AIR

In dry soil, air always occurs in the spaces between the grains. This air is very important because it allows the many living things in the soil to breathe. If there were no air in the soil, nothing would be able to live in it. The roots of plants would not be able to grow in it too.

You read earlier that the grains in a sandy soil are large while those in a clayey soil are tiny. Because of this, a sandy soil has larger spaces between the grains while a clayey soil has smaller spaces. Therefore, there is more air in dry sandy soil than in dry clayey soil. The amount of air in loam is less than that in sandy soil and more than that in clayey soil.

Things to Do

(i) We can show that soil contains air in this way. Half-fill a jug with dry garden soil and pat the soil down firmly. Gently pour water on the soil until the jug is full. You will notice that the water sinks into the soil. The water pushes out the air in the spaces. The air comes up as bubbles which burst at the water surface. Therefore, we can see that soil contains air. When no more bubbles are given out, look at the level of the water. You will find that the level has fallen.

To show that soil contains air

Repeat this with different types of soil such as sandy soil and clayey soil. Notice how low the water level falls for each type of soil. What does this show? Which type of soil contains most air? Why?

(ii) You can find out how much air there is in different types of soil. Take a pair of glass jars. The mouths of these jars must be of the same size. Fill one jar with garden soil and pat the soil down firmly. Sprinkle a little water on the top of the soil and pat it down once again to make the top firm. Now fill the other jar with water. Place the jar with soil on top of the jar with water, mouth-to-mouth. Hold both jars together firmly and quickly turn them upside down so that the jar with water is now on top of the jar with soil. The water in the top jar will sink into the soil and you will see bubbles of air coming up from the soil into the top jar. Wait for some time until no more bubbles come up into the top jar. You will find that the water level has fallen and that there is some air above the water surface in the top jar. Mark the water level and measure the length of the jar which is filled with air. Repeat the experiment with sandy and clayey soils. Which soil contains most air — the sandy, clayey or garden soil?

SOIL CONTAINS WATER

The water present in soil is very important to plants and animals. This is because all living things need water. Sandy soil with its large air spaces can contain more water than clayey soil with its small air spaces. But sandy soil cannot hold water for long. The water passes through it very quickly. Clayey soil does not allow water to run through it easily. It can hold on to so much water that we say

a clayey soil is **water-logged**. Loam can contain less water than clayey soil. Water runs through loam less quickly than it does through sandy soil. But water runs through loam more quickly than it does through clayey soil.

When it rains, water collects on the surface of the soil and runs downwards through it. It collects in the lower layers of the soil to form a **water table**. After the rain stops the soil dries up and water from below climbs upwards. Water climbs upwards fastest in clayey soil and slowest in sandy soil.

Things to Do

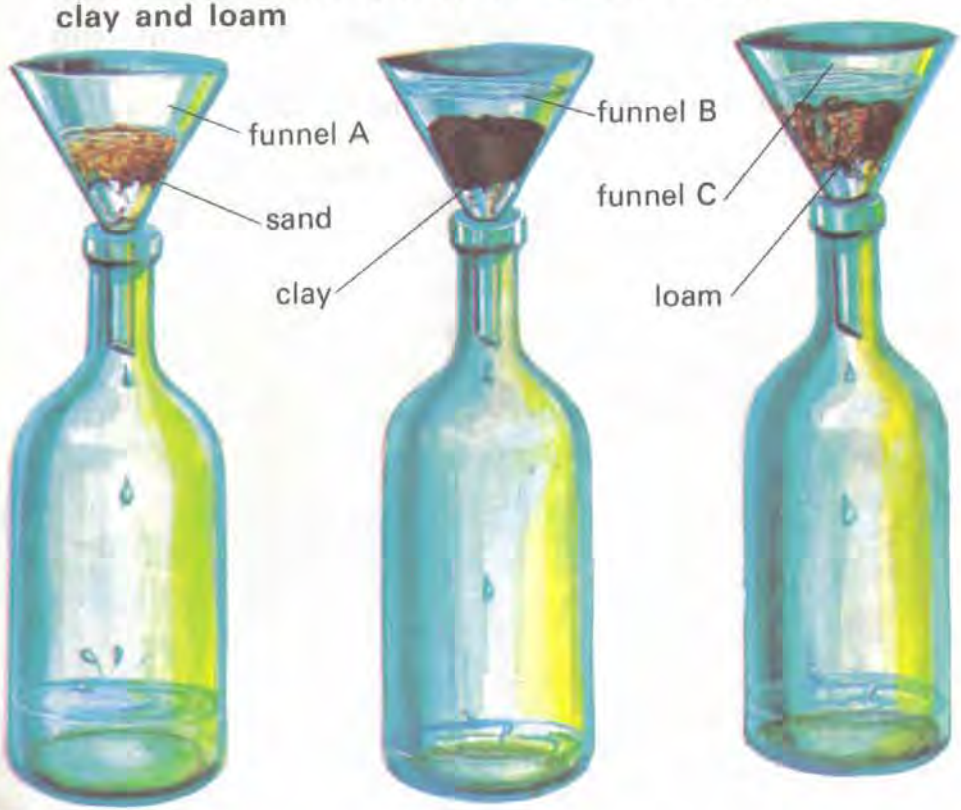
(i) We can show that soil contains water in this way. Collect some soil and put it into a tin. Weigh the tin and the soil together. Then cover the tin and heat it. After five minutes remove the cover. You will see that there are small drops of water on the insides of the tin and the cover. Where does this water come from? Now weigh the tin and the soil again. Does the tin and the soil weigh more or less now? Why?

(ii) Collect some garden soil in a tin and leave the tin on its side in the sun for some time. Later, touch the inside surface of the tin. Which part of the tin is damp? Why? Where did the water come from?

(iii) To find out how fast water runs through sand, clay and loam, we can do this. Take three funnels and put some cotton wool in the mouths of each. Put a handful of sand into funnel A, clay into funnel B and loam into funnel C. Place each funnel on an empty bottle. Pour half a glass of water into each of the funnels. After five minutes see how much water has run into the bottles.

A lot of water has run through the sand in A. Very little water has run through the clay in B. For the loam in

To find out how fast water drains through sand, clay and loam

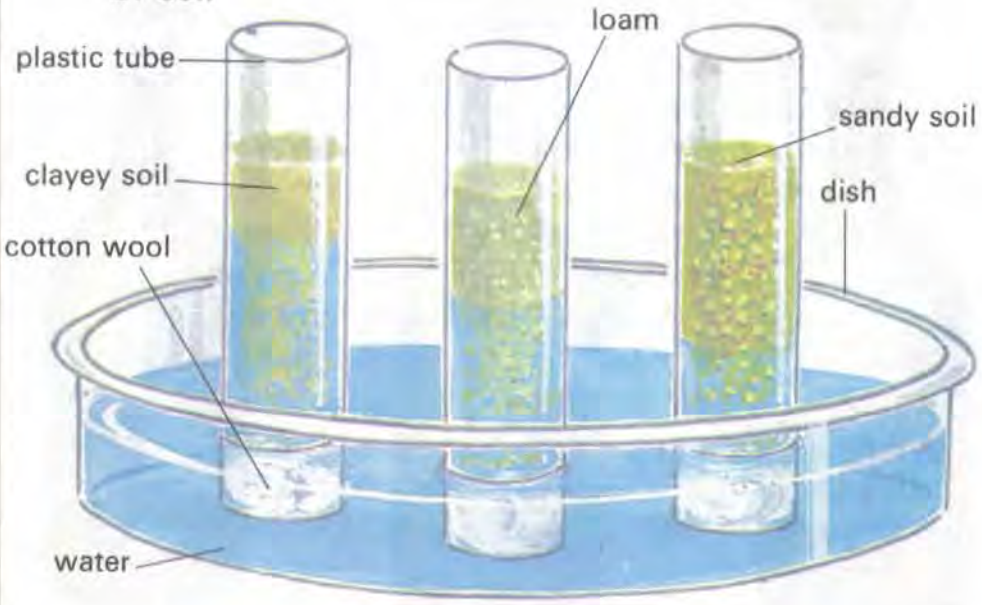


C, the amount of water that has run through was less than that for the sand and more than that for the clay.

This also shows that clay holds back a lot of water, loam holds back some water and sand holds back very little water.

(iv) You can find how far water climbs in different types of soil by doing this. With a sheet of thick plastic and some adhesive tape, make a plastic tube. Stand the tube in an empty dish. Plug some cotton wool at the lower open end of the tube. Next, fill the tube with dry sandy soil. Make two other tubes in the same way. Fill one with loam and the other with clayey soil. Place these tubes in the

To find how far water climbs in different types of soil



dish as well. Pour water into the dish until it is about 3 centimetres deep. The water soon begins to climb up the three types of soil. After some time, measure how high the water has climbed in each tube. You will find that it has climbed up highest in the clayey soil and lowest in the sandy soil.

SOIL CONTAINS HUMUS

Humus is very important because it adds certain salts to the soil. These salts are taken up by plant roots. Plants need these salts to grow and remain healthy. Soil which is light in colour, such as sandy soil, does not have much humus. Soil which is dark in colour, such as garden soil, is rich in humus.

Things to Do

(i) Collect some garden soil and heat it on a tin lid. Watch what happens. You will see little pieces of dried plant and animal remains turning red and burning. These pieces are bits of humus.

(ii) Now find a place near your school where there is a lot of plant waste such as dead leaves, grass and pieces of stems. Look for these things:
   (*a*) fresh water,
   (*b*) waste which is partly decayed, and
   (*c*) waste which is dried up.

(iii) Next, find a place in your school where there is no plant waste at all. Why is there no plant waste? Is it because the soil is made up of sand?

SOIL AND PLANT GROWTH

Plants need sunlight, air, water and salts to grow. Plants cannot grow well in sand because they do not get enough water from sand. As we know, water runs through sand very fast and very little water is held back. Also, there is very little humus in sand.

Plants cannot grow well in clay also. Clayey soil, which has too much water, is said to be water-logged. The roots of plants will rot when there is too much water around them. Because the small spaces between the particles of clay are filled with water, there is no space for air. The roots of plants cannot "breathe" properly. Also, there is little humus in clayey soil.

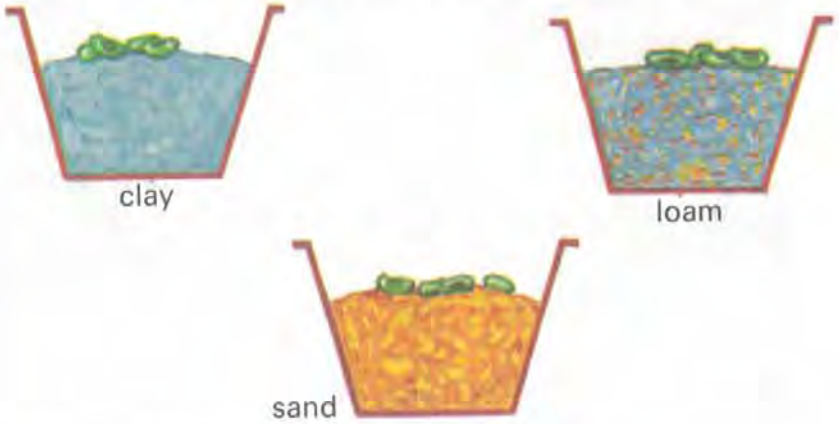
Loam is the best type of soil because it has just enough water, air and humus for plants to grow up healthy and strong. Plants need humus because it contains salts.

Things to Do

We can find out which kind of soil is best for plant growth in this way. Take three pots, fill one with sand, the other with clay and the third with loam. Put some

To find out which kind of soil is best for plant growth

AT THE BEGINNING OF THE EXPERIMENT



AFTER A FEW DAYS

These beans grow into plants which are weak, soft and pale.

These beans grow into plants which are strong and green.

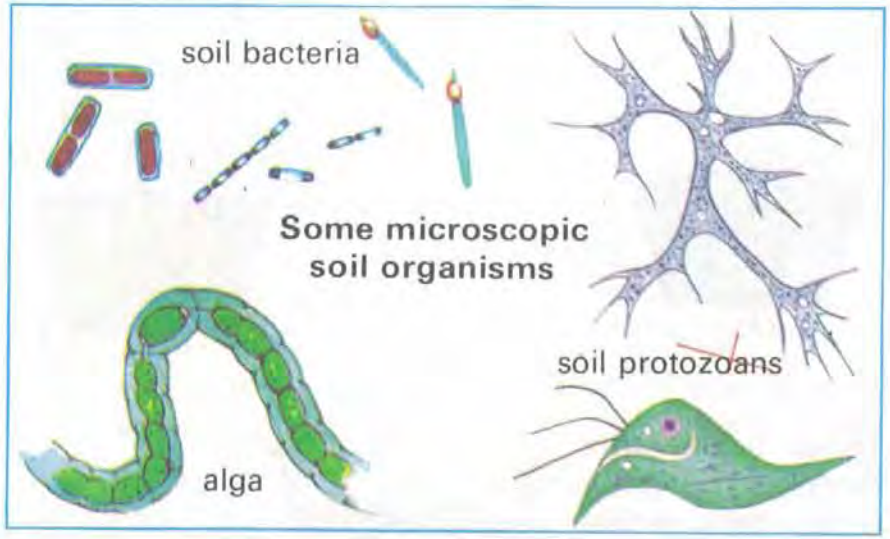
These beans grow into plants which are weak, soft and pale.

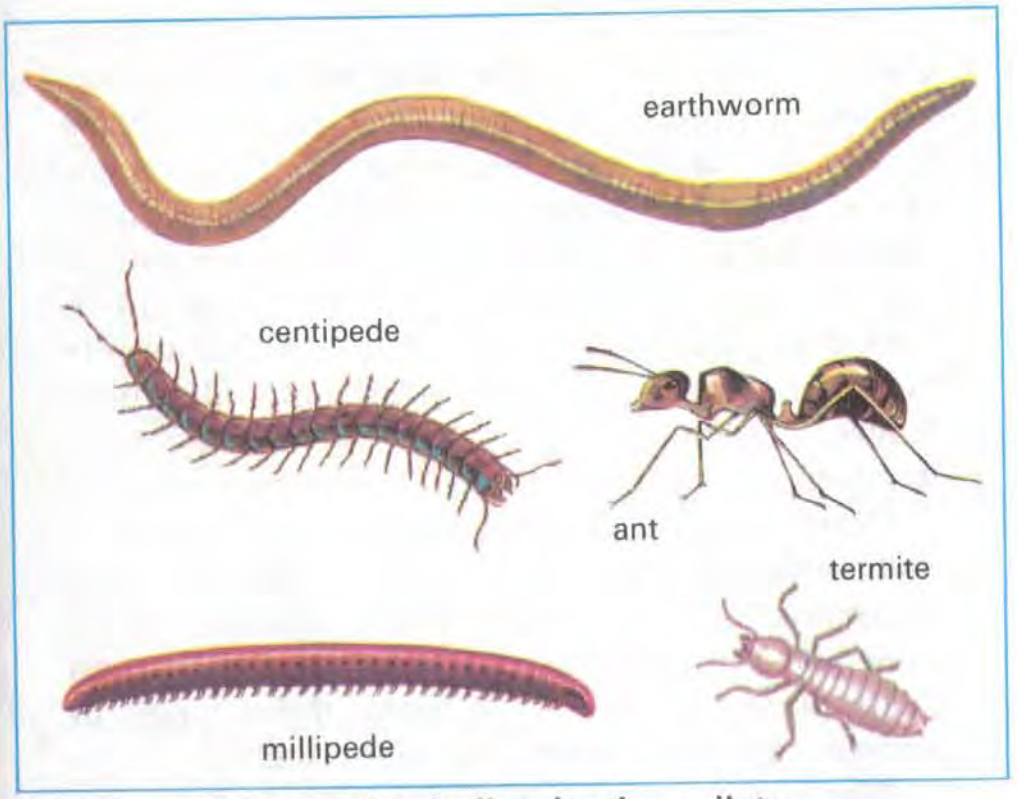
bean seeds in each pot. Put the pots in the garden and water them twice a day. In two or three days small bean plants will grow from the seeds. Leave the plants for another week and go on watering them.

You will find that the plants growing in the sand and clay are very weak. They are soft and pale. Those growing in loam are strong and green. This shows that bean plants grow best in loam.

LIFE IN THE SOIL

When you look at the soil in your garden, you may think that there is no life in the soil. But you are wrong. If you examine the soil closely, you will find that there are things living in it. There are many types of animals and plants living in the soil.





These animals live in the soil too.

Some plants and animals living in the soil are so small that we cannot see them. Because of this, we say they are **microscopic**. **Germs** or **microbes** are microscopic forms of life. Many germs live in the soil. Some of these germs can cause diseases. Others are useful because they live on dead animals and plants. Besides germs, there are other thread-like plants called **algae** living in the soil. Microscopic animals called **protozoans** are also found in the soil.

There are many insects living in the soil. Some of them, like white ants and mole

crickets, live in the soil throughout their lives. Others only live in the soil when they are adults. Insects like grasshoppers dig holes in the soil and lay their eggs in these holes. Many types of ants live in the soil. Some insects which dig into the soil have legs which are specially made for digging. The mole cricket is such an insect. Most of the insects living in the soil eat dead plant parts like dried leaves. Loam is the best soil for them because it contains a lot of dead plant parts.

Other animals like centipedes, scorpions and millipedes also live in the soil. Centipedes and scorpions live on other small animals which they kill with their poison. Millipedes live on dead plant remains. All these three types of animals are very useful to plant life.

Many different types of worms live in the soil. They are earthworms, round-worms, sand-worms and flatworms.

Rats, moles and rabbits are animals which make their homes in the soil also.

Rabbits in a burrow